

BUILDING PATTERNS WITH POLYGONS

Brief Overview:

This unit explores patterns and functions within the context of geometry. Students will explore and recognize simple patterns as well as growing patterns with the use of geometric manipulatives and problem solving. They will understand patterns, relations, and functions. Students will also gain knowledge in spatial visualization. They will recognize and interpret data using patterns.

NCTM Content Standard/National Science Education Standard:

Understand patterns, relations, and functions

- **Describe, extend, and make generalizations about geometric and numeric patterns**
- **Represent and analyze patterns and functions, using words, tables, and graphs.**

Use mathematical models to represent and understand quantitative relationships

- **Model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.**

Use visualization, spatial reasoning, and geometric modeling to solve problems

- **Build and draw geometric objects;**
- **Create and describe mental images of objects, patterns, and paths;**
- **Use geometric models to solve problems in other areas of mathematics, such as number and measurement;**
- **Recognize geometric ideas and relationships and apply them to other disciplines and to problems that arise in the classroom or in everyday life.**

Grade/Level:

Grades 3 – 4

Duration/Length:

3 days (50 – 55 minutes each day)

Student Outcomes:

Students will:

- **Identify and define the attributes of a polygon.**

- **Identify types of polygons.**
- **Build polygons using pattern blocks**
- **Draw different types of polygons**
- **Create simple and growing patterns using polygons**
- **Make connections between polygons and real world.**

Materials and Resources:

Lesson 1

- **Student Math Journals**
- **Geo-Boards with Rubber Bands**
- **Teacher Resource 1**
- **Student Resource 1**

Lesson 2

- **Student Resource 2**
- **Teacher Resource 1**
- **Overhead Projector**
- **Pattern Blocks for Overhead**
- **Pattern Blocks**
- **Student Resource 3**
- **Teacher Resource 2**

Lesson 3

- **Picture of a playground or city**
- **Overhead Projector**
- **Pattern Blocks for Overhead**
- **Pattern Blocks**
- **Teacher Resource 3**
- **Student Resource 4**
- **Teacher Resource 4**
- **Student Resource 5**
- **Teacher Resource 5**
- **Student Resource 6**
- **Teacher Resource 6**

Development/Procedures:

Lesson 1 – Polygon Introduction

Pre – Assessment –

- In pairs students will identify different shapes they see around the classroom.
- They will draw and label the different shapes in their math journals.
- Give students 5 – 7 minutes to do this. (Set a timer)
- Come together as a class and share findings.

Launch –

- Say: *“Today we are going to learn about polygons. You will identify different types of polygons based on their attributes.”*
- Ask – *What do you think polygons are?*
- Make a web containing student responses.

Teacher Facilitation –

Distribute geoboards and bands to each student.

- Students will explore with the Geo-Board.
- Ask the students to make a three-sided closed shape, then a four sided closed shape and so on.
- Students will hold up their three-sided shape. Ask: *“What do you notice about everyone’s three-sided shape? Do they look the same?”* Ask this with each shape the students make.
- After making these shapes, ask: *“What do all the shapes you have made have in common?”*
- Share the definition of a polygon.
 - A 2-dimensional closed figure made with straight lines.
- Draw various shapes on the board and after each shape, ask students have to identify if it’s a polygon using thumbs up (yes-it’s a polygon) or thumbs down (no-it’s not a polygon).
- Include examples of shapes that are not polygons.
- Ask students to justify their responses.
- As a class students will make a chart on the board to include the different polygon shapes, the name of each polygon, the number of sides, and angles.
 - See Teacher Resource 1.

Student Application –

- Students will receive a copy of Student Resource 1.
- Students will fill in the chart.

Embedded Assessment –

- Teacher will ask the students – *“What relationship do you see between the number of sides and the number of angles?”*

- Have the students write their responses on the back of Student Resource 1.

Reteaching/Extension –

- Website – <http://www.mathcats.com/explore/polygons.html>
- Students will make a foldable book that includes the definition of a polygon and names of at least three polygons with the number of sides and the number of angles.

Lesson 2 – Polygon Patterns

Pre – Assessment –

- Students will name the shape, sides, and angles of polygons.
 - Student Resource 2
 - Answer Key – Teacher Resource 1
- Go over responses with the students.

Launch –

- Place pattern blocks in a paper bag.
- Have a student come up to the front of the room and have the student pick a block without looking and describe the shape to the class.
- The class has to then guess what pattern block the student is touching.
- Repeat three to four times.

Teacher Facilitation –

- Using the overhead projector the teacher will use pattern block triangles and hexagons to create an A B pattern.
- Explain that the first shape in the pattern is identified as A and the second shape would be identified as B.
- Ask the students: *“What do you notice about the A blocks?”*
- The students will answer that all the A blocks are the same.
- Ask the students: *What do you notice about the B blocks?*
- The students will answer that all the B blocks are the same.
- Say: We have just created an AB pattern.
- The teacher will then post the definition of a pattern.
 - A pattern is a predictable sequence of figures, numbers, or other items that repeats at least three times.
- The teacher together with the students will create another type of pattern. This pattern could be in an ABB format. The pattern should repeat at least 3 times.
- Each time ask: *What polygon comes next?*

Student Application –

- Students will work in pairs with pattern blocks.
- They will create a pattern that repeats at least 4 times.
- Students will then trace their pattern onto a sentence strip and label the polygons and identify what type of pattern they have created. (ex. AB or ABB and so on)

Embedded Assessment –

- The students will present their complete sentence strip patterns to the class.
- The presenter will share what type of pattern they have created.
- You and the class will then assess the presenters understanding.

Reteaching/Extension –

- Website – <http://www.mathcats.com/explore/polygons.html>
- Students who need more practice should complete Student Resource 3.
- Answer key can be found on Teacher Resource 2.

Lesson 3 – Growing Patterns

Pre – Assessment –

- Draw a circle on the board.
- Then draw a circle and one petal.
- Draw a circle and two petals.
- Ask the students: “*What do you think I will draw next?*”
- Hopefully students will answer a circle and three petals.
- Continue until you have completed the flower.

Launch –

- Students will investigate the pattern of growth.
- Using the overhead projector and the triangles from the pattern blocks the teacher will ask the students to create different patterns.
- The teacher will place one triangle in the middle of the overhead and ask the students to surround it with other triangles.

Teacher Facilitation –

- The teacher will ask, *what do you notice about the number of sides and the number of triangles needed?*
- Students will notice that to surround the one triangle they will need three triangles that is also the number of sides.
- The students will continue predicting, surrounding, and recording until they have built the sixth design.
- See Teacher Resource 3.

Student Application –

- Students will work in pairs to build a growing pattern with squares, rhombi, and hexagons to create the fifth design.
- Students will record each step of their design on Student Resource 4.
- See answer key on Teacher Resource 4.

Embedded Assessment –

- Ask the following questions:
 1. How many blocks did it take to surround the triangle?
 2. How many blocks did it take to surround the square, rhombus, and hexagon?
 3. What relationship do you see between the blocks, shapes, and the growing pattern?
 4. Can you explain why the numbers grow as they do?
- Explain the concept of a function.
 - Function is the relationship between 2 numbers.
- Ask, “What is the rule between the number of polygons and the number of polygons that surround them.

Reteaching/Extension –

- Student Resource 5
- Teacher Resource 5
- Student Resource 6
- Teacher Resource 6

Summative Assessment –

Students will demonstrate their understanding of algebra and patterns by completing selected response questions and brief constructed response questions. The assessment – Student Resource 7 (answer key Teacher Resource 7) will integrate the skills that students have been taught by requiring the students to use the academic content and apply their knowledge in a practical manner. For example the students will have to identify polygons and patterns and complete patterns using polygons as well as justify their thinking. Finally, the students will be expected to use logical mathematical reasoning and appropriate mathematical vocabulary as they complete their answers.

Authors –

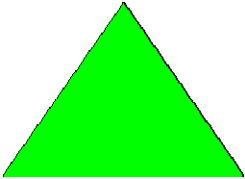

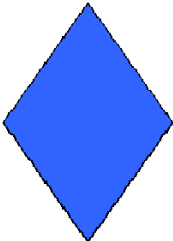

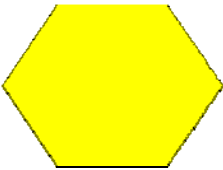
**Shannon Dana Dodd
Thomas Johnson Elementary School
Baltimore City Public Schools, MD**

**Maria O’Connell
Ravensworth Elementary School
Fairfax County Public Schools, VA**

Teacher Resource 1

Name: _____ Date: _____

Directions: Name each shape; identify the number of sides, and the number of angles for each polygon.

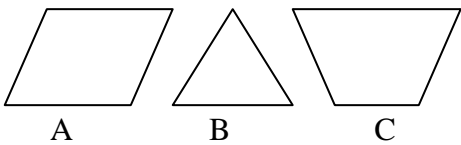
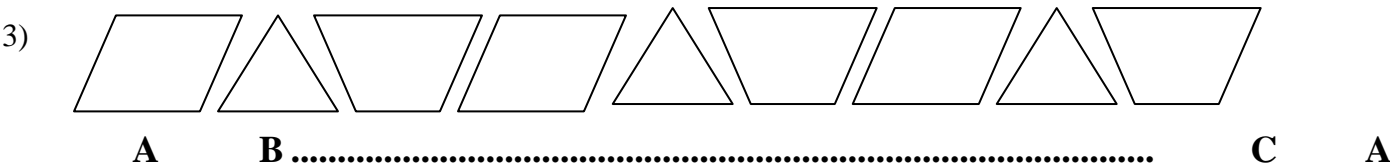
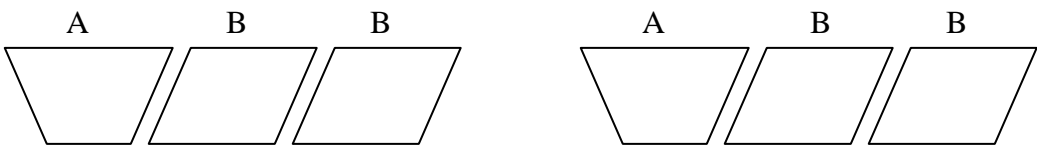
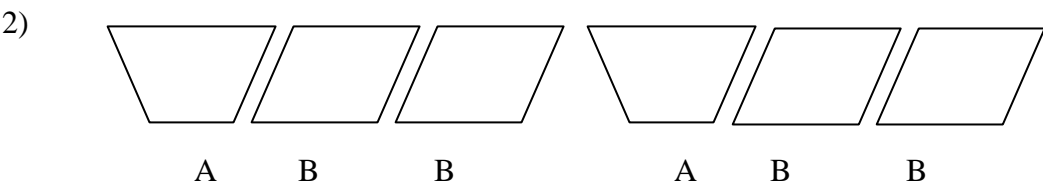
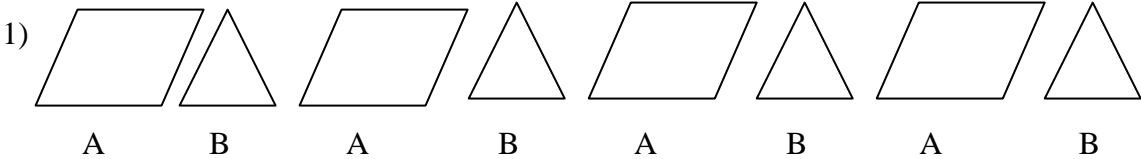
Shape	Name	Number of sides	Number of Angles
	Triangle	3	3
	Square	4	4
	Rhombus	4	4
	Trapezoid	4	4
	Hexagon	6	6

Repetitive Patterns



Name: _____ Date: _____

Directions: - Complete the following patterns.
- Make sure that the pattern repeats at least 4 times.
- Identify what type of pattern you have completed. (Ex., AB/ABB).



The Growing Triangle

Name: _____ Date: _____

Number of Triangles	Number of Surrounding Triangles
1 triangle	3
3 triangles	6
6 triangles	9
9 triangles	12
12 triangles	15
15 triangles	18

Growing Patterns

Name: _____ Date: _____

Number of Squares	Number of Surrounding Squares
1 square	4
4 squares	8
8 squares	12
12 squares	16

Number of Rhombus	Number of Surrounding Rhombuses
1 rhombus	4
4 rhombuses	8
8 rhombuses	12
12 rhombuses	16

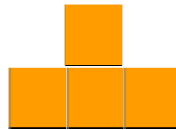
Number of Hexagons	Number of Surrounding hexagons
1 hexagons	6
6 hexagons	12
12 hexagons	18
18 hexagons	24

Growing Patterns

Name: _____ Date: _____

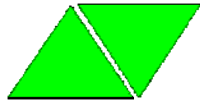
Complete the fourth steps in the following patterns.

1)

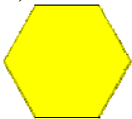


Four cubes will surround the center cube. It should look like

2)



3)



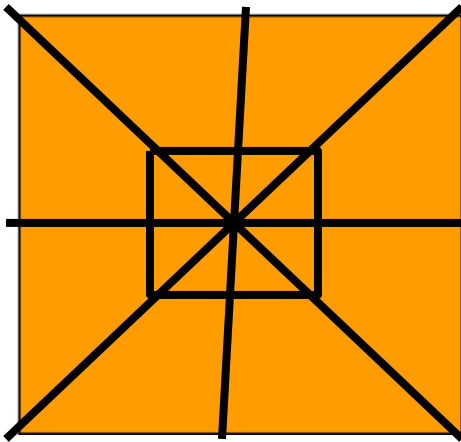
Students will build hexagons around the first hexagon.

Can You Count The Triangles?

Name: _____ Date: _____

Look at the following picture.

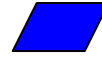
1. How many triangles can you count?



There are 28 triangles in the figure.

Teacher Resource 7 – Summative Assessment

What Do You Know About Polygons and Patterns?



Name: _____ Date: _____

1.

A. Draw a polygon.

Answers will vary for parts A and B.

B. How do you know your answer is correct? Use what you know about polygons in your explanation. Use words, numbers, and or symbols in your explanation.


2. Draw a pattern using the ABB design.

Answers will vary.

3. Using squares, triangles, rhombuses, or trapezoids create your own pattern and explain the design that you created.

Answers will vary.













4. Using triangles from the pattern blocks create a growing pattern. Use the chart below to help you.

Triangle 	# of blocks added	Total # of blocks
1 st	1	1
2 nd	2	3
3 rd	3	6
4 th	4	10
5 th	5	15
6 th	6	21

5. A polygon is –

- a. An open figure with three sides
- b. A closed figure with one curved side
- c. A closed 2 dimensional figure with straight sides
- d. A closed 2 dimensional figure with 2 straight sides and 2 curved sides



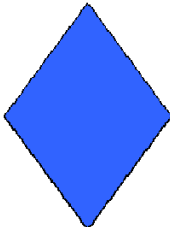

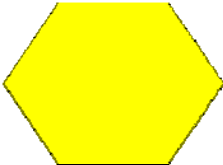
6. Which of the following patterns shows an AB patter

- a.   
- b.   
- c.   
- d.   

Student Resource 1

Name: _____ Date: _____


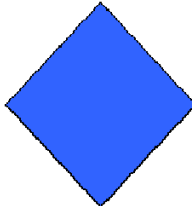
Directions: Name each shape; identify the number of sides, and the number of angles for each polygon.

Shape	Name	Number of sides	Number of angles
			
			
			
			
			

Student Resource 2

Name: _____ Date: _____

Directions: Fill in the blanks. Draw the shape, name the shape, identify the number of sides, and the number of angles for each polygon.

Shape	Name	Number of Sides	Number of Angles
			
	square		
			
		4 sides	
			6 angles

Repetitive Patterns

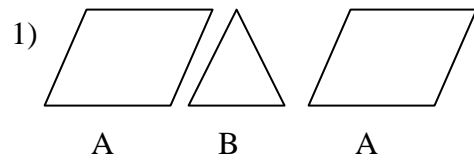


Name: _____ Date: _____

Directions: - Extend the following patterns.

- Make sure that the pattern repeats at least 4 times.

- Identify what type of pattern you have completed. (Ex., AB/ABB).



Student Resource 4

Growing Patterns

Name: _____ Date: _____

Number of Squares	Number of Surrounding Squares
1 square	4
4 squares	8

Number of Rhombuses	Number of Surrounding Rhombi
1 rhombus	4
4 rhombuses	

Number of Hexagons	Number of Surrounding hexagons
1 hexagons	6

Growing Patterns

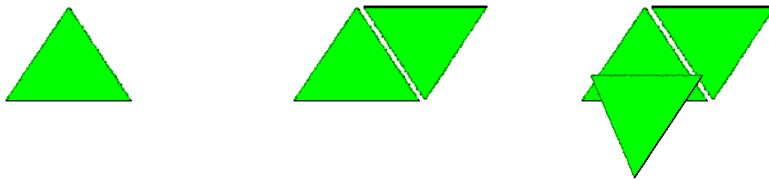
Name: _____ Date: _____

Complete the fourth steps in the following patterns.

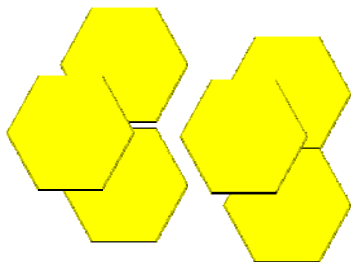
1)



2)



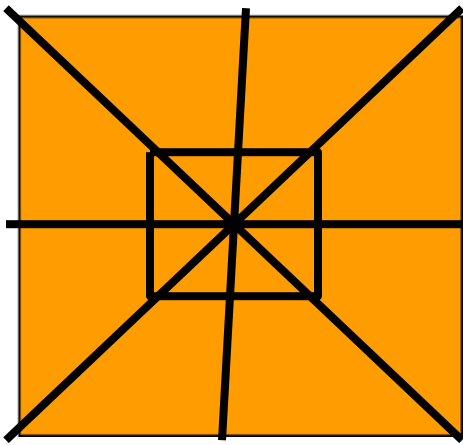
3)



Can You Count The Triangles?

Name: _____ Date: _____

Look at the following picture. How many triangles can you count?



Assessment

What Do You Know About Polygons and Patterns?



Name: _____ Date: _____

1.


C. Draw a polygon.

D. How do you know your answer is correct? Use what you know about polygons in your explanation. Use words, numbers, and or symbols in your explanation.

2. Draw a pattern using the ABB design.

3. Using squares, triangles, rhombuses, or trapezoids create your own pattern and explain the design that you created.



















4. Using triangles from the pattern blocks create a growing pattern. Use the chart below to help you.

Triangle 	# of blocks added	Total # of blocks
1 st	1	1
2 nd	2	3
3 rd	3	6
4 th		
5 th		
6 th		

5. A polygon is –

- a. An open figure with three sides
- b. A closed figure with one curved side
- c. A closed 2 dimensional figure with straight sides
- d. A closed 2 dimensional figure with 2 straight sides and 2 curved sides

7. Which of the following patterns shows an AB patter ☐

- a.      
- b.      
- c.      
- d. 